[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23–7, 34 FR 13087, Aug. 13, 1969; Amdt. 23–34, 52 FR 1829, Jan. 15, 1987]

§ 23.335 Design airspeeds.

Except as provided in paragraph (a)(4) of this section, the selected design airspeeds are equivalent airspeeds (EAS).

(a) *Design cruising speed, V_C.* For V_C the following apply:

(1) Where W/S'=wing loading at the design maximum takeoff weight, V_c (in knots) may not be less than—

(i) 33 $\sqrt{(W/S)}$ (for normal, utility, and commuter category airplanes);

(ii) 36 $\sqrt{(W/S)}$ (for acrobatic category airplanes).

(2) For values of W/S more than 20, the multiplying factors may be decreased linearly with W/S to a value of 28.6 where W/S =100.

(3) V_C need not be more than 0.9 V_H at sea level.

(4) At altitudes where an M_D is established, a cruising speed M_C limited by compressibility may be selected.

(b) *Design dive speed V_D.* For V_D, the following apply:

(1) V_D/M_D may not be less than 1.25 V_C/M_C; and

(2) With $V_{C\ min}$, the required minimum design cruising speed, V_D (in knots) may not be less than—

(i) 1.40 V_c *min* (for normal and commuter category airplanes);

(ii) 1.50 $V_{C\ min}$ (for utility category airplanes); and

(iii) 1.55 $V_{C\ min}$ (for acrobatic category airplanes).

(3) For values of W/S more than 20, the multiplying factors in paragraph (b)(2) of this section may be decreased linearly with W/S to a value of 1.35 where $W/S=100$.

(4) Compliance with paragraphs (b)(1) and (2) of this section need not be shown if V_D/M_D is selected so that the minimum speed margin between V_C/M_C and V_D/M_D is the greater of the following:

(i) The speed increase resulting when, from the initial condition of stabilized flight at V_C/M_C, the airplane is assumed to be upset, flown for 20 seconds along a flight path 7.5° below the initial path, and then pulled up with a load factor of 1.5 (0.5 *g.* acceleration increment). At least 75 percent maximum continuous power for reciprocating engines, and maximum cruising power for turbines, or, if less, the power required for V_C/M_C for both kinds of engines, must be assumed until the pullup is initiated, at which point power reduction and pilot-controlled drag devices may be used; and either—

(ii) Mach 0.05 for normal, utility, and acrobatic category airplanes (at altitudes where M_D is established); or

(iii) Mach 0.07 for commuter category airplanes (at altitudes where M_D is established) unless a rational analysis, including the effects of automatic systems, is used to determine a lower margin. If a rational analysis is used, the minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts), and the penetration of jet streams or cold fronts), instrument errors, airframe production variations, and must not be less than Mach 0.05.

(c) *Design maneuvering speed V_A.* For V_A, the following applies:

(1) V_A may not be less than $V_S\sqrt{n}$ where—

(i) V_S is a computed stalling speed with flaps retracted at the design weight, normally based on the maximum airplane normal force coefficients, C_{NA}; and

(ii) *n* is the limit maneuvering load factor used in design

(2) The value of V_A need not exceed the value of V_C used in design.

(d) *Design speed for maximum gust intensity, V_B.* For V_B, the following apply:

(1) V_B may not be less than the speed determined by the intersection of the line representing the maximum positive lift, C_{NMAX}, and the line representing the rough air gust velocity on the gust V-n diagram, or $V_{S1}\sqrt{n_g}$, whichever is less, where:

(i) n_g the positive airplane gust load factor due to gust, at speed V_C (in accordance with § 23.341), and at the particular weight under consideration; and

(ii) V_{S1} is the stalling speed with the flaps retracted at the particular weight under consideration.

(2) V_B need not be greater than V_C.

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§ 23.337 Limit maneuvering load factors.

(a) The positive limit maneuvering load factor *n* may not be less than—

(1) 2.1+(24,000÷(W+10,000)) for normal and commuter category airplanes,

where W=design maximum takeoff weight, except that n need not be more than 3.8;

(2) 4.4 for utility category airplanes; or

(3) 6.0 for acrobatic category airplanes.

(b) The negative limit maneuvering load factor may not be less than—

(1) 0.4 times the positive load factor for the normal utility and commuter categories; or

(2) 0.5 times the positive load factor for the acrobatic category.

(c) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.

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§ 23.341 Gust loads factors.

(a) Each airplane must be designed to withstand loads on each lifting surface resulting from gusts specified in § 23.333(c).

(b) The gust load for a canard or tandem wing configuration must be computed using a rational analysis, or may be computed in accordance with paragraph (c) of this section, provided that the resulting net loads are shown to be conservative with respect to the gust criteria of § 23.333(c).

(c) In the absence of a more rational analysis, the gust load factors must be computed as follows—

$$n = 1 + \frac{K_g\, U_{de}\, V\, a}{498\,(W/S)}$$

Where—

K_g=*0.88*μ_g/5.3+μ_g=gust alleviation factor;
μ_g=2(W/S)/ρ Cag=airplane mass ratio;
U_{de}=Derived gust velocities referred to in § 23.333(c) (f.p.s.);
ρ=Density of air (slugs/cu.ft.);
W/S =Wing loading (p.s.f.) due to the applicable weight of the airplane in the particular load case.
W/S =Wing loading (p.s.f.);
C =Mean geometric chord (ft.);
g =Acceleration due to gravity (ft./sec. ^{2})
V =Airplane equivalent speed (knots); and
a =Slope of the airplane normal force coefficient curve C_{NA} per radian if the gust